AMENDMENTS TO THE CLAIMS

1. (Currently Amended) An apparatus for trans-coding between code excited linear prediction (CELP) type codecs having different bandwidths, comprising:

a first type converting means for receiving formant parameters from the input bit stream and converting formant parameters from the type specified in the input CELP format to a suitable type for formant bandwidth conversion;

a formant parameter translating means for translating formant parameters from input CELP format to output CELP format and generating translated formant parameters in an output CELP format, the formant parameter translating means to include a formant bandwidth converting means to generate bandwidth-corrected formant parameters, the formant parameter translating means further to include a formant frame rate converting means to generate frame rate-corrected formant parameters,

wherein the formant bandwidth converting means receives the input formant parameters from the first type converting means and converts the formant parameters from a bandwidth of an input CELP format to a bandwidth of an output CELP format, the formant bandwidth converting means expands the bandwidth of the formant parameters by extrapolating input line spectral frequency (LSF) coefficients into new LSF coefficients that span the bandwidth of the output CELP format to generate ~~and generates~~ the bandwidth-corrected formant parameters when the bandwidth of the input CELP format is narrower than that of the output CELP format, and the formant bandwidth converting means compresses the bandwidth of the formant parameters by truncating the input LSF coefficients from a bandwidth span of the output CELP format to generate~~and generates~~ the bandwidth-corrected formant parameters when the bandwidth of the input CELP format is wider than that of the output CELP format;

a formant parameter quantizing means for receiving the translated formant parameters and quantizing the translated formant parameters;

an excitation parameter translating means for translating excitation parameters from input CELP format to output CELP format and generating excitation parameters in an output CELP format, the excitation parameter translating means to receive the frame rate-corrected formant parameters from the formant frame rate converting means before the translated formant parameters are quantized by the formant parameter quantizing means, the excitation parameter

translating means further to convert the frame rate-corrected formant parameters to generate converted parameters, to interpolate the converted parameters by weighing sub-frames to generate interpolated parameters, and to construct a perceptual weighing filter by using the interpolated parameters; and

an excitation quantizing means for receiving the translated excitation parameters and quantizing the translated excitation parameters,

wherein the excitation parameter translating means comprises:

an excitation synthesizing means to generate an excitation signal by using input CELP format excitation parameters; and

an excitation bandwidth converting means to receive the excitation signal from the excitation synthesizing means, convert the excitation signal from the bandwidth of the input CELP format to the bandwidth of the output CELP format, and output the excitation signal having the bandwidth of the output CELP format to the perceptual weighing filter,

wherein the excitation signal is decimated from a sampling frequency of the input CELP format to a sampling rate of the output CELP format when the bandwidth of the input CELP format is wider than that of the output CELP format, the excitation signal is interpolated from the sampling frequency of the input CELP format to the sampling rate of the output CELP format when the bandwidth of the input CELP format is narrower than that of the output CELP format.

2. (Previously Presented) The apparatus as recited in claim 1, wherein the formant parameter translating means further includes:

a second type converting means for receiving the bandwidth-corrected formant parameters from the formant bandwidth converting means and converting the formant parameters from the type used in the formant bandwidth converting means to a suitable type for model order conversion;

a formant model order converting means for receiving the input formant parameters from the second type converting means and converting the formant parameters from the model order in the input CELP format into the model order in the output CELP format;

a third type converting means for receiving the order-corrected formant parameters from the formant model order converting means and converting the formant parameters from the type used in the model order converting means to a suitable type for frame rate conversion;

the formant frame rate converting means for receiving the input formant parameters from the third type converting means and converting the formant parameters from the frame rate in the input CELP format to the frame rate in the output CELP format; and

a fourth type converting means for receiving the frame rate-corrected formant parameters from the formant frame rate converting means and converting the formant parameters from the type used in the formant frame rate converting means to a suitable type for the formant parameter quantizing means in the output CELP format.

3. (Cancelled)

4. (Original) The apparatus as recited in claim 2, wherein the formant model order converting means truncates the bandwidth-corrected formant parameters and generates the model order-corrected formant parameters when the model order of the bandwidth-corrected formant parameters is higher than that of the output CELP format and extends the bandwidth-corrected formant parameters and generates model order-corrected formant parameters when the model order of the bandwidth-corrected formant parameters is lower than that of the output CELP format.

5. (Original) The apparatus as recited in claim 2, wherein the formant frame rate converting means decimates the order-corrected formant filter coefficients and generates the frame rate-corrected formant parameters when the frame rate of the order-corrected formant parameters is higher than that of the output CELP format and interpolates the order-corrected formant parameters and generates the frame rate-corrected formant parameters when the frame rate of the order-corrected formant parameters is lower than that of the output CELP format.

6. (Previously Presented) The apparatus as recited in claim 2, wherein the excitation parameter translating means includes:

a fifth type converting means for receiving the frame rate-corrected formant parameters from the formant frame rate converting means and converting the frame rate-corrected formant parameters from the type used in the frame rate converting means to a suitable type for formant coefficient interpolation;

a formant coefficient interpolating means for receiving the formant filter coefficients from the fifth type converting means and generating each of the formant filter sets for sub-frame analysis;

a sixth type converting means for receiving the formant filter coefficients of each sub-frame from the formant coefficient interpolating means and converting the formant filter coefficients of each sub-frame from the type used in the formant coefficient interpolating means to a suitable type for perceptual weighting filtering;

the perceptual weighting filtering means for receiving the formant filter coefficients from the sixth type converting means and constructs the corresponding perceptual weighting filter, then receiving the excitation signal corresponding to each sub-frame from the excitation bandwidth converting means, and performing filtering the excitation signal through the constructed perceptual weighting filter;

an adaptive codebook searching means for finding optimal pitch delay in the output CELP format for each sub-frame generally based on the conventional analysis-by-synthesis scheme using an adaptive codebook target signal, which is the output signal of the perceptual weighting filtering means and then computing an accompanying gain of the adaptive codebook; and

a fixed codebook searching means for finding the best model for the residual signal from the pre-defined codebook in the output CELP format for each sub-frame generally based on the conventional analysis-by-synthesis scheme using a signal produced by subtracting the contribution of the adaptive codebook from the adaptive codebook target signal and then computing an accompanying gain of the fixed codebook.

7. (Cancelled)

8. (Currently Amended) A method for trans-coding between CELP type codecs having different bandwidths, comprising the steps of:

a) translating formant parameters from input CELP format to output CELP format and generating translated formant parameters in an output CELP format,

wherein translating the formant parameter includes expanding the bandwidth of the formant parameters by extrapolating input line spectral frequency (LSF) coefficients into new LSF coefficients that span the bandwidth of the output CELP format to generate ~~and generating~~ bandwidth-corrected formant parameters when the bandwidth of the input CELP format is narrower than that of the output CELP format, and compressing the bandwidth of the formant parameters by truncating the input LSF coefficients from a bandwidth span of the output CELP format to generate~~and generating~~ the bandwidth-corrected formant parameters when the bandwidth of the input CELP format is wider than that of the output CELP format,

wherein translating the formant parameter further includes:

converting the formant parameters from a frame rate in the input CELP format to another frame rate in the output CELP format to generate frame rate-corrected formant parameters;

b) receiving the translated formant parameters and quantizing the translated formant parameters;

c) translating excitation parameters from input CELP format to output CELP format and generating excitation parameters in an output CELP format,

wherein translating excitation parameters further comprises:

receiving the frame rate-corrected formant parameters before the translated formant parameters are quantized;

converting the frame rate-corrected formant parameters to generate converted parameters;

interpolating the converted parameters by weighing sub-frames to generate interpolated parameters; and

constructing a perceptual weighing filter by using the interpolated parameters;

generating an excitation signal by using input CELP format excitation parameters;

converting the excitation signal from the bandwidth of the input CELP format to the bandwidth of the output CELP format, and outputting the excitation signal having the bandwidth of the output CELP format to the perceptual weighing filter, wherein the excitation signal is decimated from a sampling frequency of the input CELP format to a sampling rate of

the output CELP format when the bandwidth of the input CELP format is wider than that of the output CELP format, the excitation signal is interpolated from the sampling frequency of the input CELP format to the sampling rate of the output CELP format when the bandwidth of the input CELP format is narrower than that of the output CELP format; and

d) receiving the translated excitation parameters and quantizing the translated excitation parameters. the excitation bandwidth converting means decimates the synthesized excitation signal from a sampling frequency of input CELP format to that of output CELP format and generates the bandwidth-converted excitation signal when a bandwidth of the input CELP format is wider than that of the output CELP format, and interpolates the synthesized excitation signal from a sampling frequency of input CELP format to that of output CELP format and generates the bandwidth-converted excitation signal when the bandwidth of the input CELP format is narrower than that of the output CELP format.

9. (Currently Amended) A computer readable recording medium for executing a method of trans-coding between CELP type codecs having different bandwidths, comprising the functions of:

a) translating formant parameters from input CELP format to output CELP format and generating translated formant parameters in an output CELP format,

wherein translating the formant parameter includes expanding the bandwidth of the formant parameters by extrapolating input line spectral frequency (LSF) coefficients into new LSF coefficients that span the bandwidth of the output CELP format to generate~~and generating~~ the bandwidth-corrected formant parameters when the bandwidth of the input CELP format is narrower than that of the output CELP format, and compressing the bandwidth of the formant parameters by truncating the input LSF coefficients from a bandwidth span of the output CELP format to generate~~and generating~~ the bandwidth-corrected formant parameters when the bandwidth of the input CELP format is wider than that of the output CELP format,

wherein translating the formant parameter further includes:

converting the formant parameters from a frame rate in the input CELP format to another frame rate in the output CELP format to generate frame rate-corrected formant parameters;

b) receiving the translated formant parameters and quantizing the translated formant parameters;

c) translating excitation parameters from input CELP format to output CELP format and generating excitation parameters in an output CELP format,

wherein translating excitation parameters further comprises:

receiving the frame rate-corrected formant parameters before the translated formant parameters are quantized;

converting the frame rate-corrected formant parameters to generate converted parameters;

interpolating the converted parameters by weighing sub-frames to generate interpolated parameters; and

constructing a perceptual weighing filter by using the interpolated parameters;

generating an excitation signal by using input CELP format excitation parameters;

converting the excitation signal from the bandwidth of the input CELP format to the bandwidth of the output CELP format, and outputting the excitation signal having the bandwidth of the output CELP format to the perceptual weighing filter, wherein the excitation signal is decimated from a sampling frequency of the input CELP format to a sampling rate of the output CELP format when the bandwidth of the input CELP format is wider than that of the output CELP format, the excitation signal is interpolated from the sampling frequency of the input CELP format to the sampling rate of the output CELP format when the bandwidth of the input CELP format is narrower than that of the output CELP format; and

d) receiving the translated excitation parameters and quantizing the translated excitation parameters.